



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/632,628	08/01/2003	Bradley J. Howard	2269-5862US (02-1563.00/	4766
24247	7590	02/23/2007	EXAMINER	
TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110			DHINGRA, RAKESH KUMAR	
			ART UNIT	PAPER NUMBER
			1763	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/23/2007	PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

5

<b>Office Action Summary</b>	<b>Application No.</b> 10/632,628	<b>Applicant(s)</b> HOWARD, BRADLEY J.	
	<b>Examiner</b> Rakesh K. Dhingra	<b>Art Unit</b> 1763	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 03 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 2.14.07.
- 2a) ☐ This action is FINAL.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1,3-9 and 11-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,3-9,11-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All   b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

**DETAILED ACTION**

***Response to Arguments***

Applicant's arguments, see pages 7-11, filed 1/16/07, with respect to the rejection(s) of claim(s) 1, 16 clarifying that there is no proper teaching or suggestion to combine Tsuchiya with Shan and DeOrnellas references for adding another high frequency generator in the apparatus of Tsuchiya have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made as explained hereunder.

New reference (US Patent No. 6,849,154 – Nagahata et al) when combined with Tsuchiya et al reads on the claims 1, 16 limitations. Accordingly independent claims 1, 16 and dependent claims 3-9, 11, 13-15, 17 and 23 have been rejected under 35 USC 103 (a) as explained below. Further, remaining dependent claims 12, 18-22 have also been rejected under 35 USC 103 (a) as explained below.

***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 1, 3-9, 11, 13-17, 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuchiya et al (US Patent No. 5,716,534) in view of Nagahata et al (US Patent No. 6,849,154).**

Art Unit: 1763

Regarding Claim 1: Tsuchiya et al teach a plasma apparatus (Figures 1, 30-33) comprising a first and second frequency based power generators 29, 18 connected to electrodes 21 (upper electrode) and 4 (lower electrode) respectively. Tsuchiya et al further teach a CPU (controller) 20 that can be configured to selectively control the activation configuration (in a step manner or continuously varying) of first and second power generators 29,18 during duty cycle of a process to enable optimize the etching process (column 4, line 45 to column 6, line 45 and column 12, line 5 to column 13, line 35).

Tsuchiya et al do not teach a third frequency based power generator coupled to lower electrode.

Nagahata et al teach a plasma etching apparatus (Figure 7) comprising:

first, second and third frequency based power generators 114, 126, 122 wherein the first and third power generators 144, 126 are coupled to an upper electrode 106, and the second power generators 122 is coupled to a lower electrode 108 (claim does not recite which of the upper or lower electrode is anode or cathode or on which electrode the substrate is supported);

a phase controller (controller) 132 configured to control phase difference between second and third power generators 122, 126 respectively and to superpose the third high frequency power (from third frequency power source 126) on to first high frequency power source 144 and then applied to upper electrode 106 by detecting phases of first and second high frequency powers (column 13, line 45 to column 15, line 10).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to configure the controller of Tsuchiya et al so as to selectively activate the first, second and third power generators as taught by Nagahata et al to achieve enhanced plasma density for etching patterns having high miniaturization (column 2, lines 20-40, Nagahata et al).

Regarding Claims 3, 4: Nagahata et al teach that second power generator 122 can operate between 800 KHz to 28 MHz, and the third power generator 126 operates at 2 MHz (that is second power generator operates at least three times an operational frequency of third power generator). It would be

Art Unit: 1763

obvious to adjust the frequencies of second and third generators as per process limitations like controlling damage to substrate when the ions are down to the substrate. Further Nagahata et al also teach that first power generator is configured to operate at a frequency of about 60 MHz that is greater than frequencies of second and third power generators (column 14, lines 10-45).

Regarding Claims 5-9, 11: Tsuchiya et al teach all limitations of the claims including that apparatus (Figures 1, 30-33) uses CPU (controller) 20 to control power supplies 18, 29 for ON/OFF (active /inactive) modes to optimize the etching parameters (column 9, lines 1-15 and column 12, lines 45-65 and column 13, lines 1-25). Tsuchiya et al further teach that etching parameters can be optimized by appropriately selecting the parameters including phase difference and the power ratio of the generators (column 8, lines 20-25).

Regarding Claim 13: Nagahata et al teach that second power generator 122 can operate between 800 KHz to 28 MHz, that is the prior art anticipates the claimed range of 13.5 MHz to 60 MHz (column 14, lines 20-25).

Regarding Claim 14: Nagahata et al teach that first power generator 144 can operate at about 60 MHz, that is prior art anticipates the claimed range of 40 MHz to 100 MHz (column 14, lines 10-20).

Regarding Claims 15,23: Tsuchiya et al teach that power generator 18 (third power generator) operates at a frequency of 13.56 MHz, which anticipates the claimed frequency range of 1 MHz to 13.5 MHz (column 6, lines 1-10).

Regarding Claims 16, 17: Tsuchiya et al in view of Nagahata et al teach all limitations of the claim (as explained above under claim 1) including a vacuum chamber 2 that includes upper and lower electrodes 21, 4 respectively and a wafer W supported on chuck 8 (Figure 1 and column 4, lines 45-55 - Tsuchiya et al).

**Claims 12, 18-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tsuchiya et al (US Patent No. 5,716,534) in view of Nagahata et al (US patent No. 6,849,154) as applied to Claims 1, 16 and further in view of DeOrnellas et al (US Patent No. 6,492,280).**

Regarding Claims 12,18,19: Tsuchiya et al in view of Nagahata et al teach all limitations of the claim including that first generator is capacitively coupled to upper electrode (Tsuchiya et al, Figure 1, Column 6, lines 1-30).

Tsuchiya et al in view of Nagahata et al do not teach second and third power generators are capacitively coupled to lower electrode.

DeOrnellas et al teach an apparatus (Figure 6) that has two AC power generators 48, 50 coupled to lower electrode 42 and where the second and third power generators 48, 50 are capacitively coupled to the lower electrode 42. DeOrnellas et al also teach that the apparatus could work as inductive or capacitive plasma apparatus (DeOrnellas et al, Figure 6, Column 7, lines 55-60).

Therefore it would have been obvious to one of ordinary skill in the art at the time of the invention to use two AC power generators capacitively coupled to lower electrode as taught by DeOrnellas et al in the apparatus of Tsuchiya et al in view of Nagahata et al as per required process limitations like plasma uniformity and density (DeOrnellas et al – column 5, lines 1-65).

Regarding Claim 20: Nagahata et al teach that second power generator 122 can operate between 800 KHz to 28 MHz, and the third power generator 126 operates at 2 MHz (that is second power generator operates at least three times an operational frequency of third power generator). It would be obvious to adjust the frequencies of second and third generators as per process limitations like controlling damage to substrate when the ions are down to the substrate (column 14, lines 10-45).

Regarding Claim 21: Nagahata et al teach that second power generator 122 can operate between 800 KHz to 28 MHz, that is the prior art anticipates the claimed range of 13.5 MHz to 60 MHz (column 14, lines 20-25).

Regarding Claim 22: Nagahata et al teach that first power generator 144 can operate at about 60 MHz, that is prior art anticipates the claimed range of 40 MHz to 100 MHz (column 14, lines 10-20).

*Conclusion*

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Rakesh K. Dhingra whose telephone number is (571)-272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free)..



Rakesh Dhingra



Parviz Hassanzadeh  
Supervisory Patent Examiner  
Art Unit 1763